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New records of cercosporoid hyphomycetes from Iran

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Abstract — Eight collections from different localities in the northern provinces of Iran were obtained during spring-summer 2010–11. Seven species on eight host plants were identified: *Cercospora pantoleuca* on *Plantago lanceolata*, *Cercosporella primulae* on *Primula macrocalyx*, *C. virgaureae* on *Conyza bonariensis*, *Passalora bondartsevii* on *Medicago* sp., *Pseudocercospora danaicola* on *Danae racemosa*, *P. paraguayensis* on *Eucalyptus camaldulensis*, and *Scolecostigmina confluens* on *Crataegus melanocarpa* and *C. pseudomelanocarpa*. These taxa are new records to Iran. *Cercosporina danaicola* is recombined as *Pseudocercospora danaicola*.

Key words — *Cercospora*-like fungi, taxonomy, Asia Minor, leaf spot pathogens

Introduction

Cercosporoid fungi include over 30 morphologically similar anamorphic hyphomycetous genera that are mainly associated with leaf spots on various host plants such as cereals, vegetables, ornamentals, forest trees, and weeds (Crous & Braun 2003). *Cercospora* Fresen. is one of the largest genera in this group. In his monograph of *Cercospora*, Chupp (1954) listed over 1800 species names and accepted 1419 species. He adopted a broad generic concept and mainly considered the characteristics of conidia (hilum thickness, pigmentation, number, and arrangement). In a major taxonomic treatment, Deighton (1967, 1973, 1974, 1976, 1979) divided and reclassified many *Cercospora* species into several segregate genera, including *Cercosporella* Sacc., *Cercosporidium* Earle, *Paracercospora* Deighton, *Pseudocercospora* Speg., *Pseudocercosporella* Deighton, and *Pseudocercosporidium* Deighton. Other morphologically similar fungi are members of *Passalora* Fr. and *Scolecostigmina* U. Braun. *Cercospora* species are characterized by acicular hyaline septate conidia with conspicuous hila produced

on pigmented unbranched septate smooth conidiophores. *Cercosporella* species are easily distinguished from *Cercospora* species by colourless structures with thickened darkened conidiogenous loci. In *Pseudocercospora*, conidiogenous loci and hila are inconspicuous, not thickened, and not darkened. *Passalora* is distinguished by pigmented conidiophores and pigmented ellipsoid-fusiform to obclavate-subcylindrical conidia. *Scolecostigmina* is diagnosed by thick-walled verruculose conidiophores with conspicuous annellations in the upper part. Conidia in this genus are subcylindric-obclavate, smooth to verruculose, transversely multi-euseptate, and occasionally with a few longitudinal septa. Crous & Braun (2003) published an annotated checklist for *Cercospora* and *Passalora* names with 5720 taxa and taxonomic re-allocations of numerous species. Recently Braun & Crous (2007) proposed several new species, combinations, and names after re-examining the type collections of *Cercospora* species and other related genera.

Iranian records of *Cercospora* and other related genera have been only poorly studied. Scharif & Ershad (1966) presented a list of fungi on various host plants including a few *Cercospora* and *Pseudocercospora* species. Ershad (1990, 2000, 2002) reported four *Cercospora* species from Iran and later (Ershad 2009) corrected 59 *Cercospora* names previously published from Iran, partly according to Crous & Braun (2003), thus reducing the number of species to 22 with 14 uncertain species. He did not follow Crous & Braun (2003) in merging morphologically indistinguishable taxa on various host plants in *Cercospora apii* s. lat. Recently Pirnia et al. (2010, 2012a, 2012b) studied *Cercospora*, *Passalora*, *Ramularia,* and *Ramularia*-like species in Iran following the species concepts proposed by Crous & Braun (2003) and Braun (1998). They linked six host plants with *C. apii* s. lat. Furthermore, some specimens deposited in the fungus reference of the Iranian Ministry of Agriculture (Iranian Research Institute of Plant Protection, Tehran) have been examined and proved to be morphologically indistinguishable from *C. apii*.

Materials & methods

Specimens with leaf spot symptoms from different localities in northern Iran (i.e., Guilan, Mazandaran, Golestan, northern Khorasan provinces) were collected during spring-summer 2010–11. Microscopic slides were prepared from stromata, conidiophores, and conidia in 25% lactic acid. Species were identified based on stromata (presence/absence) and their development, conidia (pigmentation, shape, dimensions), hila (thickness, darkness), conidiophores (pigmentation, dimensions) and conidial scars (position, thickness, darkness). Drawings were made using a drawing tube attached to an Olympus BH-2 microscope.

Results

In our study on cercosporoid hyphomycetes of Iran, we identified 70 taxa on 100 host plants (Table 1). Of the 21 taxa that are new records for the mycobiota

Table 1. Cercosporoid hyphomycetes and hosts identified from Iran

Pathogen	Hosts
**Cercospora acnidae*	*Amaranthus chlorostachys* var. *chlorostachys*
C. althaeina	**Gossypium hirsutum*
**C. apii*	*Abutilon theophrasti*, *Euphorbia heterophylla*, *Gerbera jamesonii*, *Medicago* sp., *Pelargonium zonale*, *Petunia hybrida*, *Solanum lycopersicum*, *Vigna sinensis*, *Zantedeschia aethiopica*
C. beticola	*Beta vulgaris*, *B. maritima*
**C. bizzozeriana*	*Cardaria draba*
**C. caricis*	*Carex orbicularis*
C. cheiranthi	*Cheiranthus cheiri*
C. lactucae-sativae	*Lactuca sativa*, **L. serriola*
**C. mercurialis*	*Mercurialis annua*
**C. pantoleuca*	*Plantago lanceolata*
**C. peckiana*	*Rumex sanguineus*, *R. crispus*
C. sorghi	**Sorghum halepense*
C. traversiana	*Trigonella foenum-graecum*
C. violae	*Viola sylvestris*, *Viola* sp.
C. zebrina	*Medicago* sp.
C. zonata	*Vicia faba*
**Cercosporella primulae*	*Primula macrocalyx*
**C. virgaureae*	*Conyza bonariensis*
Neoovularia ovata	*Salvia hypoleuca*, *S. limbata*, *S. nemorosa*
Passalora bolleana	*Ficus carica*
**P. bondartsevii*	**Medicago* sp.
P. calotropidis	*Calotropis procera*
**P. chaetomium*	*Euphorbia marschalliana*
P. circumscissa	*Cerasus vulgaris*, *Prunus domestica*
P. cousiniae	*Cousinia* sp.
P. dubia	**Chenopodium album*
P. graminis	**Agropyron* sp., **Poa annua*, **Stipa* sp.
P. microsora	*Tilia begoniifolia*
P. personata	*Arachis hypogaea*
P. phaeopappi	*Phaeopappus aucheri*
P. punctum	*Anethum graveolens*, *Foeniculum vulgare*, *Petroselinum sativum*
P. rosae	**Rosa persica*, *Rosa* sp.
P. rosicola	*Rosa* sp.
**P. ziziphi*	*Ziziphus spina-christi*
Pseudocercospora abelmoschi	*Hibiscus cannabinus*
P. atromarginalis	*Solanum nigrum*
P. cruenta	*Vigna sinensis*
**P. danaicola*	*Danae racemosa*
**P. griseola*	*Phaseolus vulgaris*
**P. heteromalla*	*Rubus* sp.
P. jujubae	*Ziziphus spina-christi*
P. kaki	*Diospyros lotus, D. kaki*
P. neriella	*Nerium oleander*
**P. paraguayensis*	*Eucalyptus camaldulensis*
P. punicae	*Punica granatum*

Table 1, concluded

Pathogen	Hosts
P. rubi	*Rubus* sp.
**P. salicina*	*Salix alba*
P. salvadorae	*Salvadora persica*
P. sphaerellae-eugeniae	*Eugenia jambos*
P. vitis	*Vitis sylvestris*, *V. vinifera*
Ramularia anchusae	*Anchusa italica*, *A. ovata*
R. brunnea	*Tussilago farfara*
R. cynarae	*Carthamus oxyacantha*, *C. tinctorius*
R. geranii var. *geranii*	*Geranium pyrenaicum*
R. grevilleana var. *grevilleana*	*Fragaria* x *ananassa*, *Potentilla reptans*
R. heraclei	*Heracleum persicum*
**R. inaequalis*	**Calendula persica*
R. lamii var. *lamii*	**Mentha piperita*, *Mentha* sp.
**R. macularis*	*Chenopodium album*
**R. pratensis* var. *pratensis*	*Rumex crispus*, *Rumex* sp.
R. rhabdospora	*Plantago lanceolata*
R. rubella	**Rumex conglomeratus*
R. rumicis	*Rumex crispus*
R. sambucina	*Sambucus ebulus*
R. simplex	*Ranunculus oxyspermus*, *R. sahendicus*
R. uredinicola	Uredinia of *Melampsora* sp. on *Salix babylonica*
R. urticae	*Urtica dioica*, *Urtica urens*
Ramulariopsis gossypii	*Gossypium hirsutum*
**Scolecostigmina confluens*	*Crataegus melanocarpa*, *C. pseudomelanocarpa*
Sirosporium celtidis	*Celtis australis*

* = new pathogen and host records

of Iran, seven are treated in detail in this paper. All specimens are deposited in the fungus reference of Iranian Ministry of Agriculture "IRAN" at the Iranian Research Institute of Plant Protection. Synonyms are listed in Crous & Braun (2003) and Braun (1995, 1998).

Taxonomy

Cercospora pantoleuca Sacc., Michelia 1: 268 (1878) Fig. 1

Leaf spots circular, numerous, brown to blackish brown with gray center, 1–3 mm in diameter; caespituli amphigenous, mostly epiphyllous, punctiform; stromata small to fairly prominent, brown, 20–25 µm wide; conidiophores fasciculate, 8–15 stalks, arising through stomata, pale olivaceous-brown, paler towards the tip, aseptate or with few inconspicuous septa, straight, subcylindrical to geniculate-sinuous, not branched, smooth, thin, 15–50 × 2.5–5 µm; conidial scars conspicuous, thickened and darkened, terminal and lateral, 1.5–2 µm wide; conidia formed singly, hyaline, acicular, narrowly obclavate, straight to

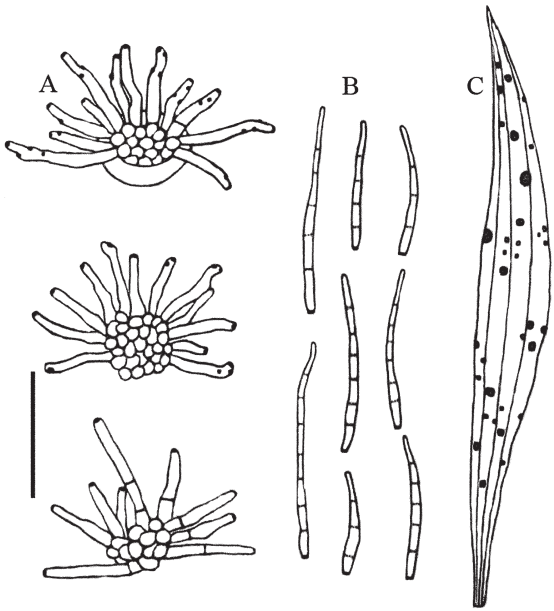

Fig. 1. *Cercospora pantoleuca* on *Plantago lanceolata*.
A. Conidiophores, B. Conidia, C. Symptoms on leaf (Bar = 50 μm).

slightly curved, smooth, thin, 3–7-septate, base truncate, tip obtuse to subacute, 40–90 × 2.5–4 (–5) μm; hilum thickened and darkened.

Specimen examined: **IRAN**, **Northern Khorasan province**, Shirvan, on *Plantago lanceolata* L., 3 July 2011, B. Bicharanlou (IRAN 15498 F).

Note—This species is characterized by short conidiophores and conidia. Conidiophores are pale olivaceous-brown to subhyaline, and conidial scars are conspicuous, terminal, and lateral. These characters distinguish this species from other *Cercospora* species. The Iranian specimen examined closely resembles Braun's (1995) description of this species but slightly differs in having faintly pigmented conidiophores.

Cercosporella primulae Allesch., Ber. Bayer. Bot. Ges. 2: 18 (1892) Fig. 2

Leaf spots circular to subcircular, yellowish, ochraceous to brown, margin indefinite, surrounded by a yellowish halo, 2–8 mm in diameter; caespituli amphigenous, punctiform, whitish; stromata substomatal to intraepidermal, composed of few swollen hyphal cells, colourless; conidiophores in small fascicles, 3–5 stalks, rarely solitary, arising through stomata or erumpent through the cuticle, hyaline, straight to geniculate-sinuous, not branched, smooth, thin-

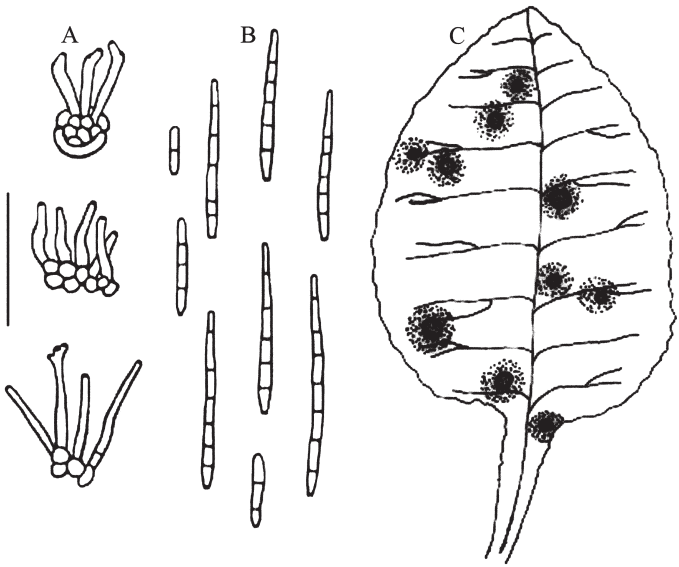

Fig. 2. *Cercosporella primulae* on *Primula macrocalyx*.
A. Conidiophores, B. Conidia, C. Symptoms on leaf (Bar = 50 µm).

walled, 0–1-septate, 20–45 × 2.5–5 µm; conidial scars conspicuous, thickened; conidia formed singly, hyaline, obclavate-acicular to subcylindrical, smooth, thin, indistinctly multiseptate, 0–7-septate, base truncate to obconically truncate, tip subacute, 20–85 × 3–5 µm; hilum slightly thickened and darkened.

Specimen examined: **IRAN**, **Golestan province**, Gorgan, on *Primula macrocalyx* Bunge, 13 May 2011, M. Pirnia (IRAN 15479 F).

Note—This taxon is characterized by moderately short and hyaline conidiophores and conidia. Because of its hyaline conidiophores and conidia as well as the structure of the scars, Braun (1995) maintained this species in *Cercosporella*.

Cercosporella virgaureae (Thüm.) Allesch., Hedwigia 34: 286 (1895) Fig. 3

Leaf spots subcircular to irregular, at first yellowish brown, later grayish brown, 2–6 mm in diameter; caespituli hypophyllous, whitish to grayish white, punctiform to dense; stromata substomatal, composed of some aggregated swollen hyphal cells, conidiophores fasciculate, 3–8 stalks, arising from stromata, emerging through stomata, hyaline, below straight, geniculate-sinuous towards the apex, not branched, 0–1-septate, 25–65 × 4–8 µm; conidiogenous cells integrated, terminal; conidial scars conspicuous, thickened and darkened, terminal and lateral; conidia formed singly, hyaline, subcylindrical to obclavate,

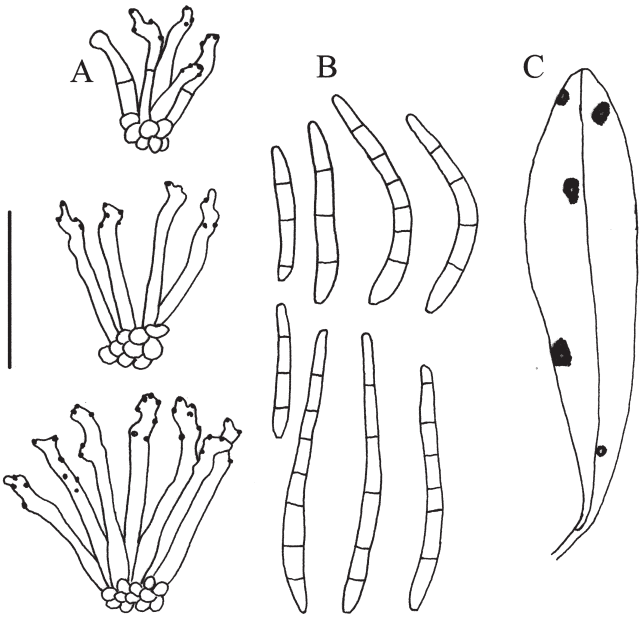

Fig. 3. *Cercosporella virgaureae* on *Conyza bonariensis*.
A. Conidiophores, B. Conidia, C. Symptoms on leaf (Bar = 50 μm).

straight to slightly curved, smooth, thin, multiseptate, 3–7 septa, base truncate to obconically truncate, tip mostly obtuse, 40–95 × 4–7 μm; hilum distinct.

Specimen examined: **IRAN**, **Guilan province**, Lahijan, on *Conyza bonariensis* (L.) Cronquist, 29 Nov. 2010, M.R. Mirzaee (IRAN 15480 F).

Note—Morphology of the specimen examined agrees with the description provided by Braun (1995). *Cercosporella virgaureae* is widespread and has a wide host range on many genera of Asteraceae. This taxon is well characterized by hyaline to subhyaline structures, long conidiophores and conidia, and numerous conspicuous conidial scars on conidiophores.

Passalora bondartsevii U. Braun & Melnik, Trudy Bot. Inst. im. V.L. Komarova 20: 43 (1997) Fig. 4

Leaf spots circular to irregular, pale brown, surrounded by a yellowish halo, 5–10 mm in diameter; caespituli epiphyllous, punctiform; conidiophores in small to dense fascicles, 7–20 stalks, arising from stromata, brown, erect, subcylindrical, slightly geniculate-sinuous towards the apex, smooth, thin, continuous to septate, sometimes constricted at the septa, 40–90 × 4–5 μm;

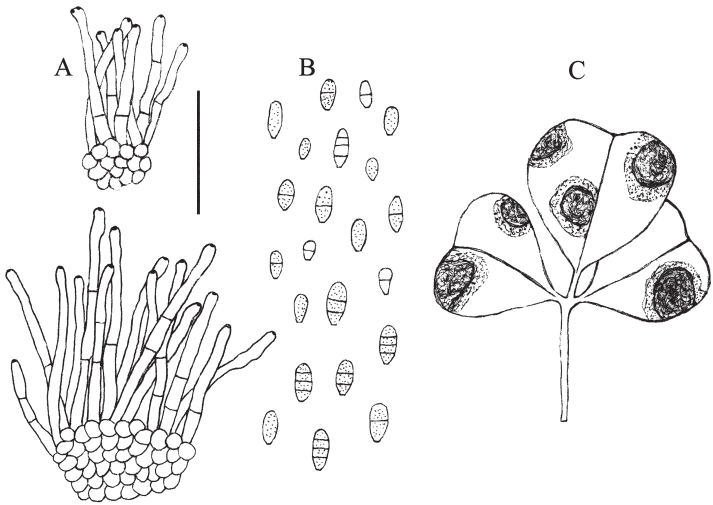

Fig. 4. *Passalora bondartsevii* on *Medicago* sp.
A. Conidiophores, B. Conidia, C. Symptoms on leaf (Bar = 50 μm).

conidiogenous cells integrated, terminal; conidial scars moderately thickened and darkened; conidia formed singly, olivaceous-brown, ellipsoid, obovoid, smooth to rough, 0–3-septate, base obconically truncate, apex obtuse to rounded, 10–20 × 5–7.5 μm; hilum darkened, unthickened to slightly thickened.

Specimen examined: **IRAN, Mazandaran province**, Babolsar, on *Medicago* sp., 25 June 2011, M. Rafiee (IRAN 15499 F).

Note—This taxon was originally established by Braun & Melnik (1997) on *Onobrychis vicifolia* Scop., from Russia and is only known from the type collection. *Passolora bondartsevii* is diagnosed by ellipsoid-obovoid to obclavate-subcylindrical, smooth to faintly rough conidia. In our specimen the conidia are ellipsoid, obovoid, and mostly rough, but we did not see any obclavate-subcylindrical conidia. However, other characters agree well with the description in Braun & Melnik (1997). Therefore, we assign the Iranian collection tentatively to *P. bondartsevii* even though another host genus is involved.

Pseudocercospora danaicola (Vienn.-Bourg.) Pirnia & Zare, **comb. nov.** Fig. 5

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≡ *Cercosporina danaicola* Vienn.-Bourg. Ann. Phytopathol. 2(4): 689 734 (1971 ["1970"]) as "*danaecola*".

Leaf spots circular to subcircular, sometimes with spacious blight specially at the tip of leaves, reddish brown, 10–15 mm in diameter; caespituli amphigenous,

punctiform; stromata present, globular, well developed, dark brown, 45–60 µm wide; conidiophores in dense fascicles, arising from stromata, pale olivaceous-brown, subcylindrical, sinuous, rarely once geniculate, not branched, smooth, thin, aseptate, 8–30 × 2–3 µm; conidiogenous loci inconspicuous; conidial scars unthickened and inconspicuous; conidia formed singly, pale olivaceous, acicular, straight to slightly curved, smooth, thin, indistinctly 1–5-septate, base truncate, tip subacute, 65–130 × 2.5–4 µm; hilum inconspicuous, unthickened and not darkened.

Specimens examined (deposited as "*Cercosporina danaecola*"): **IRAN**, **Golestan province**, Khan-bebin, Shirabad forest, on *Danae racemosa* Moench, 7 May 1976, D. Ershad (IRAN 515 F); **Mazandaran province**, Nowshahr, on *D. racemosa*, 19 Aug. 1973, collector unknown (IRAN 516 F, **neotype**, **designated here**).

Note—The name *Cercosporina danaicola* was originally published by Viennot-Bourgin based on material from Iran (Viennot-Bourgin et al. 1971). Careful microscopic examination of morphological characteristics showed that the conidiogenous loci and hila are inconspicuous, unthickened, and not darkened. Crous & Braun (2003) place species with these morphological features into *Pseudocercospora*. Type material could not be traced, but based on the Iranian

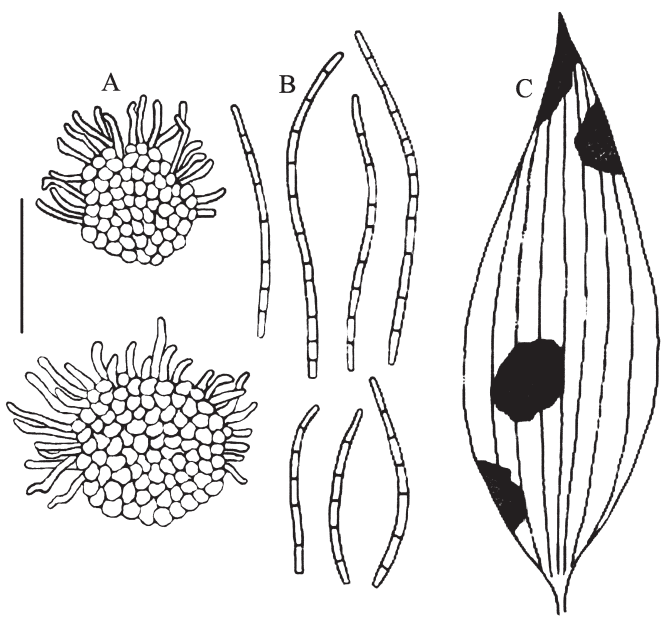

Fig. 5. *Pseudocercospora danaicola* on *Danae racemosa*.
A. Conidiophores, B. Conidia, C. Symptoms on leaf (Bar = 50 µm).

specimens examined, this species can be transferred to *Pseudocercospora*. The collection IRAN 516 is designated as neotype.

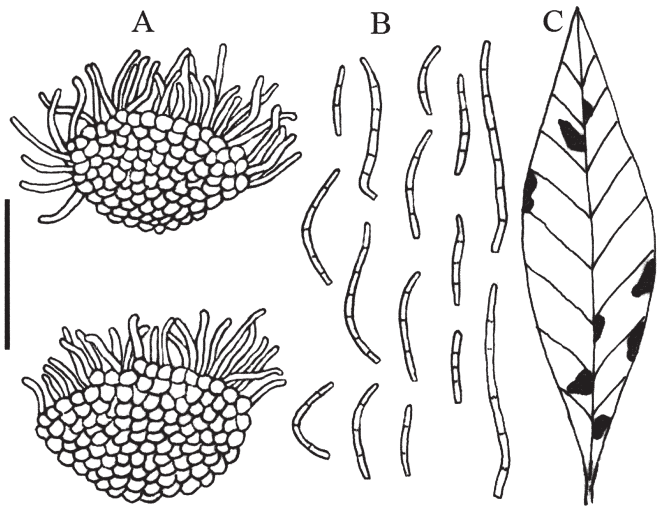

Fig. 6. *Pseudocercospora paraguayensis* on *Eucalyptus camaldulensis*. A. Conidiophores, B. Conidia, C. Symptoms on leaf (Bar = 50 µm).

Pseudocercospora paraguayensis (Tak. Kobay.) Crous, Mycotaxon 57: 270 (1996) Fig. 6

Leaf spots irregular, vein-limited, pale brown to dark grayish brown, border slightly raised, 2–5 mm in diameter, sometimes coalescing into a large blotch; caespituli amphigenous, mostly hypophyllous, punctiform; stromata present, well developed, brown, 50–70 µm wide; conidiophores densely fasciculate, compact, subhyaline to pale olivaceous, subcylindrical, aseptate, not branched, sinuous to rarely once geniculate, straight to curved, rounded at the apex, 10–30 × 2–3 µm; conidial scars unthickened and inconspicuous; conidia formed singly, subhyaline or very pale olivaceous, narrowly obclavate, straight to curved, indistinctly 2–6-septate, apex subacute or subobtuse, base truncate to obconically truncate, 22–70 × 2–3 µm; hilum inconspicuous, unthickened and not darkened.

Specimen examined: **IRAN**, **Golestan province**, Shastkola forest, on *Eucalyptus camaldulensis* Dehnh., 8 Nov. 2010, M. Pirnia & R. Zare (IRAN 15481 F).

Note—Kobayashi introduced *Cercospora paraguayensis* on *Eucalyptus* sp. from Paraguay (see Crous 1998).

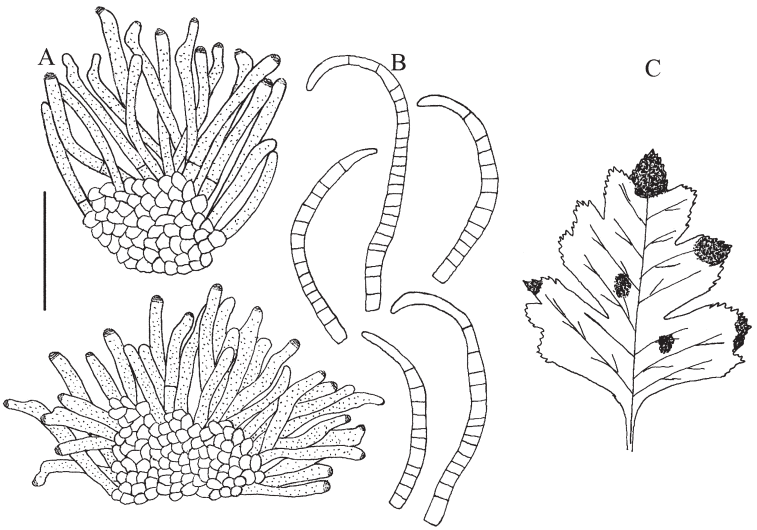

Fig. 7. *Scolecostigmina confluens* on *Crataegus pseudomelanocarpa*. A. Conidiophores, B. Conidia, C. Symptoms on leaf (Bar = 50 µm).

Scolecostigmina confluens (Lieneman) U. Braun, New Zealand J. Bot. 37: 325 (1999) Fig. 7

Leaf spots irregular, dark brown, scattered on leaf surface, but mostly at the tip and edge of leaves, 5–15 mm in diameter; caespituli amphigenous, mostly epiphyllous, punctiform; stromata prominent, subglobose, dark brown, 30–65 µm wide; conidiophores in dense fascicles, 15–30 stalks, arising from stromata, dark brown, paler and attenuated towards the apex, 0–1-septate, cylindrical, straight to curved, sinuous to rarely once geniculate in the upper part, not branched, verruculose, thick-walled, 25–75 × 4–7 µm; conidiogenous cells integrated, terminal, proliferation percurrent, annellate; conidia solitary, dark brown, paler and narrower towards the tip, subcylindrical-obclavate, slightly curved, verrucose, thick-walled, transversely pluriseptate, occasionally with few longitudinal or oblique septa, base truncate, tip subacute, 75–140 × 4–8 µm.

Specimens examined: **IRAN**, **Golestan province**, Ghorogh forest park, on *Crataegus pseudomelanocarpa* Popov ex Lincz. 14 Sep. 2010, M. Pirnia (IRAN 15472 F); **Guilan province**, Rasht, Saravan, on *C. melanocarpa* M. Bieb., 27 July 2007, A. Khodaparast (IRAN 15473 F).

Note—The genus *Scolecostigmina* was originally described as having thick-walled verruculose conidiophores with conspicuous annellations and conidia

that are subcylindrical-obclavate, smooth to verruculose, transversely multi-euseptate conidia, and occasionally with a few longitudinal septa (Braun et al. 1999).

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